

We claim:

1. An optical system for imaging a two-dimensional distribution of a magnetic field, comprising:

a light source providing light;

a polarizer disposed to polarize said light and produce linearly polarized light;

a magneto-optical imaging film structure comprising a substrate, a light reflector and at least one film exhibiting magneto-optical polarization rotation in response to the applied magnetic field, said magneto-optical imaging film further having an in-plane single easy axis type of anisotropy;

an optical illumination system that directs said polarized light toward said magneto-optical imaging film such that the light reaches said film at an angle with respect to the normal direction to the magneto-optical imaging film surface;

an optical detector, disposed in the path of light reflected from magneto-optical imaging film, providing an electrical detection signal indicative of the spatial distribution of the power of said light; and

a signal processor responsive to said electrical detection signal, for conversion of said electrical signal from the optical detector to quantitative information of the magnetization distribution of the magneto-optical imaging film, and through said processing, the extraction of quantitative information on the spatial distribution of the magnetic fields in the location of said magneto-optical imaging film.

2. The optical system of claim 1 wherein the light source comprises a light source chosen from the group consisting of a light emitting diode (LED), a superluminescent diode (SLD), a laser or a lamp.

3. The optical system of claim 1 wherein an optical collimation means is disposed after the light source to collimate the light.

4. The optical system of claim 1 wherein a band-pass filter is disposed along the path of the light after the light source.

5. The optical system of claim 1 wherein a half-wave plate is disposed along the path of the light after the light source and is further oriented to maximize the performance of said optical system.

6. The optical system of claim 1 wherein said optical illumination system comprises a lens system that is used to focus the light at a certain spot on the said magneto-optical imaging film.

7. The optical system of claim 1 wherein said optical illumination system comprises at least one lens system that is used to expand the light to illuminate a substantial part of the magneto-optical imaging film's surface.

8. The optical system of claim 1 wherein said angle at which light reaching the MOIF film is within 20 to 70 degrees from the normal to the film surface.

9. The optical system of claim 1 wherein a prism is disposed over the magneto-optical imaging film and is in immersion contact with said film to provide higher tilt of the beam with respect to the normal direction to the magneto-optical medium.

10. The optical system of claim 1 wherein an optical collimation means is disposed in the path of the light reflected from said magneto-optical imaging film.

11. The optical system of claim 10 wherein said collimation means comprises a lens or lens system.

12. The optical system of claim 1 wherein an optical polarization component is disposed along the path of the light reflected by the magneto-optical imaging film.

13. The optical system of claim 12 wherein said polarization component comprises a transmission-type polarizer which is oriented to maximize the linearity and the dynamic range of said optical system.

14. The optical system of claim 1 wherein said optical detector comprises a two-dimensional detector array, selected from the group consisting of a CCD camera and a CMOS camera.

15. The optical system of claim 1 wherein the magnetic field for which the spatial distribution is being identified is generated by electrical currents in the device-under-test.

16. An optical laser scanning system for imaging of two-dimensional distributions of magnetic fields, comprising:

- a laser light source providing light;
- an optical beam-scanner;

an optical illumination system that directs said light toward the magneto-optical imaging film structure so the light reaches said film at an angle with respect to the normal direction to the magneto-optical imaging film surface;

said magneto-optical imaging film structure comprising a substrate, a light reflector and at least one film exhibiting magneto-optical polarization rotation in response to the applied magnetic field, said magneto-optical imaging film further having an in-plane single easy axis type of anisotropy;

a polarizer disposed along the path of the light reflected from said magneto-optical imaging film;

an optical detector, disposed in the path of light reflected from magneto-optical imaging film after said polarizer, providing an electrical detection signal indicative of the power of said light; and

a signal processor responsive to said electrical detection signal, for conversion of said electrical signal from an optical detector into quantitative information of the magnetization distribution of the magneto-optical imaging film and through that the extraction of quantitative information about the spatial distribution of the magnetic fields in the location of said magneto-optical imaging film.

17. The optical laser scanning system of claim 16 wherein an optical collimation means is disposed after the laser source in order to further collimate the light.

18. The optical laser scanning system of claim 16 wherein a wave plate is disposed along the path of the light after the laser source and is oriented to maximize the performance of said optical system.

19. The optical laser scanning system of claim 18 wherein said wave plate is selected from the group consisting of a quarter- wave plate and a half-wave plate.

20. The optical laser scanning system of claim 16 wherein said optical beam-scanner comprises an angular scanning mirror system arranged to scan the two-dimensional magneto-optical imaging film.

21. The optical laser scanning system of claim 16 wherein said optical beam-scanner comprises a pair of one-dimensional angular scanning mirror.

22. The optical laser scanning system of claim 16 wherein an optical beam-splitting means is disposed along the light path between the laser source and the beam-scanner in order to redirect a portion of the light out of the main optical path towards a reference photodetector.

23. The optical laser scanning system of claim 22 wherein said photodetector provides an electrical signal to the signal processing means indicative of the power of light from the laser for the purpose of an optical power reference signal.

24. The optical laser scanning means of claim 16 wherein said optical illumination system comprises a lens system that is used to focus the light at a specific spot on the said magneto-optical imaging film

25. The optical laser scanning means of claim 16 wherein said optical illumination system comprises a lens system that is used to control of an angle of incidence of a scanned beam on magneto-optical imaging film and further means provided to mechanically adjust the position of said lens to illuminate a substantial part of the magneto-optical imaging film's surface in a single scan.

26. The optical laser scanning means of claim 16 wherein said angle at which light reaches the MOIF is within 20 to 70 degrees from the normal to the MOIF surface.

27. The optical laser-scanning system of claim 16 wherein at least one of the lenses in the illumination system is disposed on a computer processor controlled, mechanically movable stage to provide active focal-spot adjustment.

28. The optical laser scanning means of claim 16 wherein the prism is disposed over the magneto-optical imaging film and is in immersion contact with said film to provide greater tilt away from the normal to the surface of the beam with respect to the normal direction in the magneto-optical medium.

29. The optical laser scanning system of claim 16 wherein a collimation means is disposed in the path of the light reflected from said magneto-optical imaging film.

30. The optical laser scanning system of claim 29 wherein said collimation means comprises a lens or lens system.

31. The optical laser-scanning system of claim 16 wherein an optical polarization component is disposed along the path of the light reflected by the magneto-optical imaging film.
32. The optical laser-scanning system of claim 31 wherein said polarization component comprises a transmission-type polarizer which is oriented to maximize the linearity and the dynamic range of said optical system.
33. The optical laser-scanning system of claim 16 wherein said polarizer comprises a transmission-type polarizer which is oriented to maximize the linearity and the dynamic range of said optical system, and further comprising a wave plate disposed along the path of the light reflected by the magneto-optical imaging film and before said polarization component that is oriented to maximize the performance of said optical system.
34. The optical laser scanning system of claim 33 wherein said wave plate is selected from the group consisting of a quarter- wave plate and a half-wave plate.
35. The optical laser scanning system of claim 16 wherein said polarizer comprises a polarization cube beam splitter adjusted to split the beam into two beams with orthogonal polarizations, approximately at 45 degrees to the polarization of the light incident on the magneto-optical film.
36. The optical laser-scanning system of claim 35 wherein the optical detector comprises two photodetectors disposed in the paths of the two beams resulting from said polarization beam-splitter.
37. The optical laser-scanning system of claim 16 wherein the laser light is amplitude modulated at a non-zero frequency by either direct modulation or by employing an external optical modulator disposed along the light path between the laser source and said magneto-optical imaging film.
38. The optical laser-scanning system of claim 37 wherein signal detector is incorporated to perform demodulation of said electrical signal from the photodetectors at the frequency of modulation.
39. The optical laser-scanning system of claim 16 wherein magnetic field which spatial distribution is being identified is generated by the electrical currents in the device-under-test.

40. An optical dual-path system for imaging a two-dimensional distribution of magnetic fields, comprising:

a magneto-optical imaging film comprising a substrate, at least one film exhibiting magneto-optical polarization rotation in response to an applied magnetic field and having in-plane single easy axis type of anisotropy and a light reflector, two optical paths with each of said paths comprising
a light source providing light;
a polarizer disposed to polarize said light, producing linearly polarized light; an optical illumination system in each path that directs said polarized light toward the magneto-optical imaging film such that the light reaches said film at an angle with respect to the normal direction to the magneto-optical imaging film surface for the first of said optical paths and in the normal direction to the magneto-optical imaging film surface for the second of said optical paths;
an optical detector, disposed in the path of light reflected from magneto-optical imaging film, providing an electrical detection signal indicative of the spatial distribution of the power of said light;
a signal processor responsive to said electrical detection signals from both optical detectors corresponding to both optical paths, for conversion of said electrical signal from an optical detector into the quantitative information of the magnetization distribution of the magneto-optical imaging film and through that extracting the quantitative information on the spatial distribution of the magnetic fields in the location of said magneto-optical imaging film.

41. The optical system of claim 40 wherein the light sources are chosen from the group consisting of a light emitting diode (LED), a Superluminescent diode (SLD), a laser or a lamp.

42. The optical system of claim 40 wherein an optical collimation means is disposed after each light source to collimate the light in each of said optical paths.

43. The optical system of claim 40 wherein a band-pass filter is disposed along the path of the light from each light source in each of said optical paths.

44. The optical system of claim 40 wherein a half-wave plate is disposed along the path of the light from each light source and each half-wave plate is oriented to maximize the performance of said optical system in the respective optical path.

45. The optical system of claim 40 wherein said optical illumination system comprises a lens system that is used to focus the light at a specific spot on the said magneto-optical imaging film in each of said optical paths.

46. The optical system of claim 40 wherein said optical illumination system comprises a lens system in each of said optical paths for the purpose of expanding the light beams in order to illuminate a substantial part of the surface of the magneto-optical imaging film with each expanded beam .

47. The optical system of claim 40 wherein said angle at which light reaches the MOIF is within 20 to 70 degrees from the normal to the MOIF surface in the first of said optical paths.

48. The optical system of claim 40 wherein a prism is disposed over the magneto-optical imaging film and is in immersion contact with said film to provide a greater tilt away from the normal direction to the magneto-optical imaging film for the first of said optical paths while not affecting the direction of the second beam that is incident normal to the MOIF surface.

49. The optical system of claim 40 wherein a collimation means is disposed in each of said optical paths in the path of the light reflected from said magneto-optical imaging film.

50. The optical system of claim 49 wherein said collimation means comprises a lens or lens system.

51. The optical system of claim 40 wherein an optical polarization component is disposed in each of said optical paths along the path of the light reflected by the magneto-optical imaging film.

52. The optical system of claim 51 wherein said polarization component comprises a transmission-type polarizer that is oriented to maximize the linearity and the dynamic range of said optical system in each of said optical paths.

53. The optical system of claim 40 wherein said optical detection means comprises a two-dimensional detector array, selected from the group consisting of a CCD camera and a CMOS camera in each of said optical paths.

54. The optical system of claim 40 wherein the magnetic fields being imaged are generated by the electrical currents in the device-under-test.

55. An optical system for imaging of a two-dimensional spatial distribution of a magnetic field, comprising:

a light source providing light;
a polarizer disposed to polarize said light, producing linearly polarized light;
an optical illumination system that directs said polarized light toward the magneto-optical imaging film;

said magneto-optical imaging film structure comprising a substrate and a thin film indicator structure, said indicator structure applied to said substrate and comprising a plurality of thin-film layers disposed on said substrate, at least one of said layers being of magneto-optically (MO)-active material having predetermined magnetic properties including magnetic anisotropy, magnetization saturation value, coercive field value, preferably having in-plane single easy axis type of anisotropy and a known magneto-optical effect value; said indicator structure including an additional at least one of said layers having a thickness and/or refractive index modulated in a predetermined fashion; said indicator structure having at least one optical mode which is at least partially localized in said at least one MO-active layer or at one interface of said at least one MO-active layer; and said at least one optical mode which is at least partially localized in said one layer having modulated thickness and/or refractive index;

an optical detector, disposed in the path of light reflected from magneto-optical imaging film, providing an electrical detection signal indicative of the spatial distribution of the power of said light; and

a signal processor responsive to said electrical detection signal, for conversion of said electrical signal from the optical detector into quantitative information about the magnetization distribution in the magneto-optical imaging film and through that

the extraction of quantitative information about the spatial distribution of the magnetic fields in the location of said magneto-optical imaging film.

56. The optical system of claim 55 wherein the light source comprises a light source chosen from the group consisting of a light emitting diode (LED), a Superluminescent diode (SLD), a laser or a lamp.

57. The optical system of claim 55 wherein an optical collimation means is disposed after the light source to collimate the light.

58. The optical system of claim 55 wherein a band-pass filter is disposed along the path of the light after the light source.

59. The optical system of claim 55 wherein a half-wave plate is disposed along the path of the light after the light source and is further oriented to maximize the performance of said optical system.

60. The optical system of claim 55 wherein said optical illumination system comprises a lens system that is employed to focus the light at a specific spot on the said magneto-optical imaging film.

61. The optical system of claim 55 wherein said optical illumination system comprises a lens system that is used to control an angle of incidence of a scanned beam on magneto-optical imaging film and further means provided to mechanically adjust the position of said lens to illuminate a substantial part of the magneto-optical imaging film's surface in a single scan.

62. The optical system of claim 55 wherein the collimation means is disposed in the path of the light reflected from said magneto-optical imaging film structure.

63. The optical system of claim 62 wherein said collimation means comprises a lens or a lens system.

64. The optical system of claim 55 wherein an optical polarization component is disposed along the path of the light reflected by the magneto-optical imaging film.

65. The optical system of claim 64 wherein said polarization component comprises a transmission-type polarizer that is oriented in order to maximize the linearity and the dynamic range of said optical system.

66. The optical system of claim 55 wherein said optical detection means comprises a two-dimensional detector array, selected from the group consisting of a CCD camera and a CMOS camera.

67. The optical system of claim 55 wherein the magnetic field for which the spatial distribution is being identified is generated by electrical currents in the device-under-test.

68. The optical system of claim 55 wherein the incident and reflected light paths at least partially coincide.

69. The optical system of claim 68 wherein a semitransparent mirror is disposed along the path of the light between the light source and the magneto-optical imaging film in order to divert the light reflected from said magneto-optical imaging film structure into a separate optical path.

70. The optical system of claim 69 wherein polarizing means and detection means are disposed in said separate optical path.

71. The optical system of claim 55 wherein the polarizer that is disposed along the light path between the light source and the magneto-optical imaging film is capable of providing two different orthogonal polarizations of the transmitted light according to a command from said signal processor.

72. The optical system of claim 71 wherein said different states of polarization of the light beam are selected by means of mechanical rotation of said polarizing means around the axis that coincides with the path of transmitted light.

73. The optical system of claim 71 wherein a second polarizing means, disposed along the path of the light reflected by the magneto-optical imaging film structure, is provided with the capability of causing two different orthogonal polarizations of the transmitted light according to a command from said signal processor.

74. The optical system of claim 71 wherein the image of the magneto-optical imaging film is captured by the signal processor at different states of both polarizing means and the acquired images are processed to separate different magnetization projections at every point of the image.

75. The optical system of claim 55 wherein the illumination of the magneto-optical imaging film is performed by means of a laser scanning technique.

76. The optical system of claim 75 wherein said laser scanning technique employs a two-dimensional angular scanning mirror.

77. The optical system of claim 75 wherein said laser scanner employs a pair of one-dimensional angular scanning mirrors.

78. The optical system of claim 75 wherein at least one of the lenses in the illumination system is disposed on a signal processor-controlled, mechanically movable stage to provide active focal adjustment.

79. The optical system of claim 75 wherein the polarizer is disposed in the path of the light reflected from said magneto-optical imaging structure said polarizer comprises a transmission-type polarizer that is oriented to maximize the linearity and the dynamic range of said optical system.

80. The optical system of claim 79 wherein a wave plate is disposed along the path of the light reflected by the magneto-optical imaging film structure before said analyzer component and is oriented to maximize the performance of said optical system.

81. The optical system of claim 80 wherein said wave plate is selected from the group consisting of a quarter- wave plate and a half-wave plate.

82. The optical system of claim 75 wherein the polarizer is disposed in the path of the light reflected from said magneto-optical imaging structure, said analyzer polarizer comprising a polarization cube beam splitter adjusted to split the beam into two beams with orthogonal polarizations, approximately at 45 degrees to the polarization of the light incident on the magneto-optical film structure.

83. The optical system of claim 82 wherein an optical detector comprises two photodetectors disposed in the paths of each of the two beams created by said polarization beam-splitter.

84. The optical system of claim 75 wherein the laser light is amplitude modulated at a non-zero frequency by either direct modulation or by employing an external optical modulator disposed along the light path between the laser source and said magneto-optical imaging film structure.

85. The optical laser-scanning system of claim 84 wherein a signal processor performs demodulation of said electrical signals from the photodetectors at the frequency of modulation.

86. An optical interferometer system for the imaging of a two-dimensional distribution of a magnetic field, comprising:

a light source providing light

a polarizer disposed to polarize said light, producing linearly polarized light;

an optical beam splitter dividing the beam into two spatially separate beams, a sample beam and a reference beam;

an optical illumination system that directs said sample beam toward the magneto-optical imaging film;

said magneto-optical imaging film comprising a substrate and a thin film indicator structure, said indicator structure applied to said substrate and comprising a plurality of thin-film layers disposed on said substrate, at least one of said layers being of magneto-optically (MO)-active material and having predetermined magnetic properties, including magnetic anisotropy, magnetization saturation value, coercive field value, preferably having in-plane single easy axis type of anisotropy; and a known magneto-optical effect value; said indicator structure including at least one of said layers having a thickness and/or refractive index modulated in a predetermined fashion; said indicator structure having at least one optical mode which is at least partially localized in said at least one MO-active layer or at one interface of said at least one MO-active layer; and said at least one optical mode which is at least partially localized in said one layer having modulated thickness and/or refractive index;

an optical combiner, combining the reference beam and sample beam reflected from said magneto-optical imaging film structure at an angle with respect to each other and with respect to the normal to the MOIF structure an optical polarizing means disposed in the path of the combined beam to provide means for selecting a polarization that maximizes the contrast of the interference patterns resulting from the combination of the sample and reference beams

an optical detector, disposed in the path of the combined light from the sample and reference paths, providing an electrical detection signal indicative of the spatial distribution of the power of said light;

a signal processor responsive to said electrical detection signal, said signal processor converting said electrical signal from the optical detector into quantitative information characterizing the magnetization distribution of the magneto-optical imaging film, and through that the extraction of quantitative information about the spatial distribution of the magnetic fields in the location of said magneto-optical imaging film.

87. The optical interferometer system of claim 86 wherein the light source comprises a light source chosen from the group consisting of a light emitting diode (LED), a Superluminescent diode (SLD), a laser or a lamp.

88. The optical interferometer system of claim 86 wherein an optical collimator is disposed after the light source to collimate the light.

89. The optical interferometer system of claim 86 wherein a narrow band-pass filter is disposed along the path of the light after the light source.

90. The optical interferometer system of claim 86 wherein a half-wave plate is disposed along the path of the light after the light source and is oriented to maximize the performance of said optical system.

91. The optical interferometer system of claim 86 wherein said optical illumination system comprises a lens system that is employed to focus the light at a specific spot on the said magneto-optical imaging film.

92. The optical interferometer system of claim 86 wherein said optical illumination system comprises a lens system that is used to control of an angle of incidence of a scanned beam on magneto-optical imaging film and further means provided to mechanically adjust the position of said lens to illuminate a substantial part of the magneto-optical imaging film's surface in a single scan.

93. The optical interferometer system of claim 86 wherein a collimation means is disposed in the path of the light reflected from said magneto-optical imaging film structure.

94. The optical interferometer system of claim 93 wherein said collimation means comprises a lens or a lens system.

95. The optical interferometer system of claim 86 wherein said polarization component comprises a transmission-type polarizer.

96. The optical interferometer system of claim 86 wherein said optical detection means comprises a two-dimensional detector array, selected from the group consisting of a CCD camera and a CMOS camera.

97. The optical interferometer system of claim 86 wherein the magnetic field for which the spatial distribution is being quantified is generated by electrical currents in the device-under-test.

98. A method of imaging a two-dimensional distribution of magnetic field vectors:

providing an optical dual-path system consisting of a magneto-optical imaging film structure comprising a substrate, at least one film applied to said substrate and exhibiting magneto-optical polarization rotation in response to an applied magnetic field and having in-plane single easy axis type of anisotropy and an applied light reflector and further providing two optical paths with each of said paths comprising

providing light from a light source;

polarizing said light to produce linearly polarized light;

directing said polarized light toward the magneto-optical imaging film so that the light reaches said film at some angle with respect to the normal direction to the magneto-optical imaging film surface for a first of said optical paths and at normal direction to the magneto-optical imaging film surface for a second of said optical paths;

generating an electrical detection signal indicative of the spatial distribution of the power of said light;

converting said electrical signal into quantitative information about the magnetization distribution of the magneto-optical imaging film, and through that the extraction of quantitative information on the spatial distribution of the magnetic fields in the location of said magneto-optical imaging film;

providing a pre-measured magnitude of the magnetization at the saturation of said magneto-optical imaging film at the temperature at which the actual imaging is to be performed;

providing a pre-determination of the characteristic optical system coefficients through a calibration procedure;

providing a pre-determination of the Faraday rotation per unit length of said magneto-optical imaging film at a wavelength of said light source and at the temperature at which the actual imaging to be performed;

providing and storing pre-determined magnetization curves of said magneto-optical imaging film in the directions perpendicular to the film, in-plane along the hard axis and in-plane along the easy axis by means of a calibration procedure;

providing and storing arrays of data obtained from said detection means corresponding to both optical paths in said optical dual-path system;

obtaining all components of the local vectors of magnetization of said magneto-optical imaging film at each point of measurement by means of signal processing of the recorded and stored data; and

obtaining the spatial distribution of the external magnetic field vectors by means of signal processing of the recorded and stored data.

99. The method of imaging of claim 98 wherein a DC bias magnetic field, exceeding the coercivity of the said magneto-optical imaging film, is applied along the direction of the in-plane easy axis of said film, causing the said film to be magnetized to saturation.

100. A method of imaging of claim 99 wherein said pre-determined magnetization curves are measured when said DC bias magnetic field is applied to the film.

101. A method of imaging of claim 98 wherein the component of magnetization normal to the film is determined from said characteristic optical system's pre-determined coefficients corresponding to the second optical path, the pre-determined Faraday rotation per unit length of said magneto-optical imaging film and the stored data array from the second optical path.

102. A method of imaging of claim 98 wherein the in-plane component of magnetization collinear to the hard axis of the magneto optical imaging film is determined from said pre-determined characteristic optical system's coefficients corresponding to the first optical path, the pre-determined Faraday rotation per unit length of said magneto-optical imaging film, the stored data array from the first optical path and from the said pre-determined characteristic optical system's coefficients corresponding to the second optical path, the pre-determined Faraday rotation per unit length of said magneto-optical imaging film and the stored data array from the second optical path.

103. A method of imaging of claim 99 wherein the in-plane component of magnetization collinear with the magneto-optical imaging film's easy axis is determined from said pre-determined characteristic optical system's coefficients corresponding to the first optical path, the pre-determined Faraday rotation per unit length of said magneto-optical imaging film, the stored data array from the first optical path, from the said pre-determined characteristic optical system's coefficients corresponding to the second optical path, the pre-determined Faraday rotation per unit length of said magneto-optical imaging film, the stored data array from the second optical path and from the said pre-determined value of the saturated magnetization of said magneto-optical imaging film.

104. A method of imaging a two-dimensional distribution of magnetic field vectors:

providing an optical system for the imaging of a two-dimensional distribution of the magnitude of the magnetic field vector projections:

providing a magneto-optical imaging film, said magneto-optical imaging film comprising a substrate, a thin film indicator structure, said indicator structure applied to said substrate and comprising a plurality of thin-film layers disposed on said substrate, at least one of said layers being of magneto-optically (MO)-active material and having pre-determined magnetic properties including magnetic anisotropy, magnetization saturation value, coercive field value, preferably having in-plane single easy axis type of anisotropy; and a known magneto-optical effect value; said indicator structure including at least one of said layers having a thickness and/or refractive

index modulated in a predetermined fashion; said indicator structure having at least one optical mode which is at least partially localized in said at least one MO-active layer or at one interface of said at least one MO-active layer; and said at least one optical mode is at least partially localized in said one layer having modulated thickness and/or refractive index; a light source providing light; a polarizer disposed to polarize said light, producing linearly polarized light with at least two states corresponding to TE and TM-polarized waves; an optical illumination system that directs said polarized light toward the magneto-optical imaging film; an analyzer disposed in the path of the light reflected by the magneto-optical imaging film structure with the two states associated with each of the TM and TE-polarized waves; an optical detection means, disposed in the path of light reflected from magneto-optical imaging film structure, providing an electrical detection signal indicative of the spatial distribution of the power of said light; signal processing means responsive to said electrical detection signal, for conversion of said electrical signal from an optical detection means to quantitative information about the magnetization distribution in the magneto-optical imaging film and through that the extraction of quantitative information about the spatial distribution of the magnetic fields in the location of said magneto-optical imaging film;

providing the pre-measured magnitude of the magnetization at saturation of said magneto-optical imaging film at the temperature at which the actual imaging is to be performed;

providing the pre-determination of the characteristic optical system coefficients by means of a calibration procedure;

providing the pre-determination of the Faraday rotation per unit length of said magneto-optical imaging film at a wavelength of said light source and at the temperature at which the actual imaging to be performed;

providing and storing the pre-determined magnetization curves of said magneto-optical imaging film in the directions perpendicular to the film, in-plane along the hard axis and in-plane along the easy axis by means of a calibration procedure;

providing and storing arrays or data obtained from said detection means at said two different states of polarizer and analyzer;

obtaining all components of the local vectors of magnetization of said magneto-optical imaging film at each point of measurement by means of mathematical processing of the recorded and stored data;

obtaining the spatial distribution of the external magnetic field vector by means of signal processing of the recorded and stored data by said signal processing means.

105. A method of imaging of claim 104 wherein a DC bias magnetic field exceeding the coercivity of the said magneto-optical imaging film is applied along the direction of the in-plane easy axis of said film, such that the said film is magnetized to saturation.

106. A method of imaging of claim 105 wherein said pre-determined magnetization curves are measured when said DC bias magnetic field is applied to the film.

107. A method of imaging of claim 104 wherein the component of magnetization normal to the film is determined from said pre-determined characteristic optical system's coefficients corresponding to the TE state of the polarizer and the TM state of the analyzer, pre-determined Faraday rotation per unit length of said magneto-optical imaging film and the stored data array from the said system's state corresponding to the TE state of polarizer and the TM state of analyzer.

108. A method of imaging of claim 104 wherein the in-plane component of magnetization collinear to the magneto optical imaging film's hard axis is determined from said pre-determined characteristic optical system's coefficients corresponding to the system's state associated with the TM state of polarizer and the TE state of analyzer, pre-determined Faraday rotation per unit length of said magneto-optical imaging film, the stored data array from the system's state corresponding to the TM state of polarizer and the TE state of the analyzer and from said pre-determined characteristic the optical system's coefficients corresponding to the system's state associated with the TE state of the polarizer and the TM state of the analyzer, the pre-determined Faraday rotation per unit length of said magneto-optical imaging film and

the stored data array from the system's state corresponding to the TE state of the polarizer and the TM state of the analyzer.

109. A method of imaging of claim 105 wherein the in-plane component of magnetization collinear to the magneto optical imaging film's easy axis is determined from said pre-determined characteristic optical system's coefficients corresponding to the TM state of the polarizer and the TE state of the analyzer, the pre-determined Faraday rotation per unit length of said magneto-optical imaging film, the stored data array from the TM state of the polarizer and the TE state of the analyzer and from said pre-determined characteristic optical system's coefficients corresponding to the TE state of the polarizer and the TM state of the analyzer, the pre-determined Faraday rotation per unit length of said magneto-optical imaging film and the stored data array from the TE state of the polarizer and the TE state of the analyzer and from the said pre-determined value of the saturated magnetization of said magneto-optical imaging film.

110. An optical system for imaging of a two-dimensional distribution of the magnitude of the magnetic field vector projections, comprising:

- a light source providing light
- a polarizer disposed to polarize said light, producing linearly polarized light;
- an optical illumination system that directs said polarized light toward the magneto-optical imaging film such that the light reaches said film at an angle with respect to the normal direction to the magneto-optical imaging film surface;
- said magneto-optical imaging film structure comprising a substrate, a light reflection means and at least one film exhibiting magneto-optical polarization rotation in response to the applied magnetic field, said magneto-optical imaging film further having a cubic axis type of anisotropy;
- an optical detection means, disposed in the path of light reflected from the magneto-optical imaging film, providing an electrical detection signal indicative of the spatial distribution of the power of said light;
- signal processing means responsive to said electrical detection signal, for conversion of said electrical signal from an optical detection means into quantitative information about the magnetization distribution in the magneto-optical imaging film

and through that the extraction of quantitative information about the spatial distribution of the magnetic fields in the location of said magneto-optical imaging film.